

**Correlates of Leisure-time Physical Activity Participation among
Latino Children and Adolescents with Acanthosis Nigricans**

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Running head: Physical Activity among Youth with Acanthosis Nigricans

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INTRODUCTION

Childhood obesity has become a serious public health concern in the United States. The prevalence rates of childhood obesity largely increased in the 1980s and 1990s and remained persistently high between 1999-2000 and 2007-2008 in the United States [20]. The highest extreme obesity prevalence rate, defined at the 97th percentile or higher of the age-gender-specific growth chart [13, 22], was found in Mexican American youth ages 6-11, closely followed by other Latino youth of the same age group. Childhood obesity has negative consequences on many health outcomes [19]. For example, weight-related type-2 diabetes mellitus (T2DM), previously only observed among adults, is now more and more being diagnosed in youth [1, 15]. Public health measures are urgently needed to improve early identification of at-risk youth and implement interventions effective in delaying or even preventing the development of metabolic abnormalities or other morbidities associated with obesity and insulin resistance [5, 6, 30].

One noninvasive way of identifying youth at higher risk for metabolic abnormalities is to visually check on acanthosis nigricans (AN), a condition characterized by a darkened, thickening, velvety hyperpigmentation of the skin often seen around joints and areas with lots of creases and folds like knuckles, armpits, elbows, knees, and neck [18]. This cutaneous marker signals internal impairment as it is generally caused by obesity and compensatory hyperinsulinemia, a consequence of insulin resistance that is associated with obesity [10, 27, 29]. In pediatric populations, AN is rare among non-Latino whites but is commonly found in overweight ethnic minorities such as blacks and Latinos with insulin resistance and/or type 2

diabetes [12, 18, 28]. Initiatives focusing on lifestyle changes have been found to help halt the progress of insulin resistance and decrease risk for type 2 diabetes in at-risk youth [10, 27].

Physical activity (PA) has been shown to be protective against obesity and insulin resistance syndromes and is particularly helpful for high-risk youth as it has the potential to help slow or even reverse the progress of insulin resistance syndrome associated with childhood obesity [5, 10, 17, 27]. In children and adolescents of developed countries, leisure-time PA (LTPA) is a dominant form of PA [2, 16]. Although factors of childhood LTPA have been extensively studied [2, 25], little work has been done to study PA correlates among AN-positive youth who are at higher risks of metabolic morbidities.

To enhance our understanding of group-specific PA correlates, we conducted a study focusing on AN-positive children and adolescents and examining child and parental characteristics that are associated with LTPA participation in this special pediatric population. Based on previous theoretical and empirical development [3, 7], five categories of correlates were tested separately and then jointly, including child sedentary behavior (competing against LTPA), child health condition, parental socioeconomic status, parental health condition, and parental physical activity including exercise and house work. Findings from this study are expected to help improve the effectiveness of interventions specifically targeted to overweight/obese children who are highly prone to insulin resistance and obesity-related comorbidities.

METHODS

Data

Data used in this study were from the 2012 Survey on Family Background Associated with Acanthosis Nigricans (SFBAAN). The main purpose of this cross-sectional survey was to collect

information on family demographics, socioeconomic status, health insurance coverage, diet, physical activities, family history of diabetes and other variables for AN-positive students identified in the Texas Risk Assessment for Type 2 Diabetes in Children (TRAT2DC) program. The TRAT2DC is a legislatively mandated program administered by The Border Health Office of University of Texas Pan American (UTPA) that annually screens over one million children for AN in selected Texas Education Agency Regional Education Service Centers. Despite its large samples size, the TRAT2DC does not collect any information on family background of AN-positive students. To fill this gap, the SFBAAN was conducted in a local school district near UTPA in 2012. Based on the TRAT2DC data collected from August 2011 to May 2012, 770 out of 8,581 students screened (approximately 9%) from our selected school district were identified with AN. In August 2012, school nurses were asked to distribute survey questionnaires to these AN-positive students for them to take home for their parents to fill in. A total of 330 primarily completed questionnaires were returned, with a 43% response rate.

The study took place in the Lower Rio Grande Valley at the southern tip of Texas, where the vast majority of the local population is of Mexican origin. For analytical purposes, we only included Latinos in the analyses. The working sample was comprised of 305 parent-child pairs with each pair consisting of an AN-positive child and his or her biological parent. The survey was approved in May 2012 by the Institutional Review Board (IRB) at UTPA.

Measures

Our outcome variable was LTPA participation, which was measured by the following question asked of the participant parent: "On average, how often does your child have physical exercises or sports after school?" It had five response categories including 'never,' 'less than once a week,' 'about once or twice a week,' 'every other day,' and 'every day.'

Independent variables included both child and parental characteristics selected according to the PA correlate literature in general pediatric populations [2, 9, 14, 26]. Child age (continuously measured) and gender (male versus female) were controlled in all the models. In addition, at the child-level, a sedentary lifestyle variable was included, namely time spent watching TV or playing video games. It was categorized into four ordinal groups corresponding to quartiles of the average minutes the child spent watching TV or playing video games each day as reported by the interviewed parent with the lowest quartile as the reference group. Four dichotomous variables measuring health conditions were also included: obesity (95th or greater BMI percentile on CDC's age-gender-specific growth charts) [21], fair or poor parent-rated health (SRH), hypertension, and diabetes.

At the parental level, three categories of variables were tested, including socioeconomic status, health conditions, and physical activities. Socioeconomic status was measured by three variables: years of education (3 levels: high school or below, college, above college), employment status ('work full time,' 'work part time,' 'unemployed or other'), and per capita family income (continuously measured). Four dichotomous variables of health conditions were included: parental obesity, parental diabetes, extended family's diabetes, and parental fair/poor SRH. In addition, two PA-related behavioral variables were included: physical exercise (PE) participation and time spent doing housework each day. Parental PE participation was assessed by the question "On a typical day, how much time (in minutes) do you spend on physical exercises such as walking, jogging, hiking, swimming, or playing a ball game?" and was further dichotomized into less than 30 minutes versus 30 minutes or more per day. We also added a missing category to the parental PE variable to avoid sample reduction due to missing responses.

Parental time spent in housework was measured by the question “On a typical day, how much time (in minutes) do you spend on housework such as cleaning, gardening, or cutting grass?” and was then standardized in the regression model.

Statistical analyses

Sample descriptive statistics were calculated. Multiple ordinal logit regression analyses were performed to examine the associations between covariates and the ordinal outcome variable: LTPA participation. Model 1 examined child age, gender and the child’s TV/game time per day. Model 2 focused on child health factors including obesity, hypertension, diabetes, and fair/poor SRH based on parental assessment. Models 3 through 6 tested parental characteristics, focusing on socioeconomic characteristics (Model 3), health conditions (Model 4), and PE or housework engagement (Model 5). Model 6 is the final model including significant covariates that were identified in previous models and remained significant in the final round of multivariate regression. Statistical analyses were conducted using Stata 11.

RESULTS

Table 1 presents the sample statistics. Mean age of the sampled youth is 10.5 years old. About 43 percent of the children in the sample engage in LTPA less frequently than once every other day and about 9 percent report no LTPA participation. The vast majority of the sampled children are obese (91 percent). The prevalence of diabetes is low, around 4.9 percent, but nearly 23 percent of the children in the sample have hypertension and about 15 percent have fair/poor health based on parental assessment. Nearly 74 percent of the children report spending at least 2 hours on watching TV or playing video game every day. As to parental health conditions, the prevalence of obesity is 62 percent, lower than that of the children but considerably higher than the national average of adult obesity. While the majority of the parents are not diabetic, the prevalence of

having one extended family member diabetic is as high as 71 percent. Sixty-one percent of the parents report spending at least 30 minutes per day on physical exercise. On average, parents spend two and a half hours per day on housework.

Table 2 shows the results of multiple ordinal logit regression analyses. Among child-level covariates (Models 1 and 2), TV/game and fair/poor SRH are the only two variables found to be statistically significant; both are negatively associated with the odds of the child's participating in one-level higher of LTPA and both remain significant in the final multivariate modeling (OR of TV/time greater than 2 hours versus fewer than 45 minutes per day=0.45, $p=0.01$; OR of fair/poor SRH versus good/very good/excellent health=0.42, $p=0.01$). Among parent-level covariates (Models 3 through 5), three are significant or marginally significant in both the reduced model and the final model. Parental obesity (OR=0.63, $p=0.06$) and parental time spent in doing housework (OR=0.76, $p=0.03$) are negatively associated with child LTPA participation levels whereas parental PE participation (OR=2.20, $p<0.01$) is a positive correlate.

DISCUSSION

Maintaining a healthy lifestyle is particularly beneficial for AN-positive youth as they are more prone to suffering from morbidities associated with obesity and insulin resistance [10, 27, 29].

Due to their increased risk for negative health outcomes and related complications, more attention should be given to at-risk youth [30]. Our goal was to identify significant LTPA correlates of AN-positive youth to aid interventions aimed to promote LTPA in this special pediatric population.

None of the usual parental socioeconomic suspects was significantly correlated with child's LTPA participation in our analyses. Our empirical testing of a rich set of child- and parent-level variables as potential child LTPA correlates identified five health or PA-related

behavioral factors that sustained multivariate modeling. Among the five, the only positive or PA-promoting factor is the parent's spending 30 minutes or more on PE per day. The other four factors are all negative covariates, including the child's spending more than 2 hours per day on watching TV or playing videogames (versus those reporting 45 minutes or less screen time), the child's parent-rated fair/poor health, the parent's obesity, and the parent's housework time.

Two key messages can be gleaned from these findings. First, parenting is crucial in cultivating healthy behaviors of children, a finding concordant with previous work [4, 8]. Parents' strategizing their children's time use in daily routines to consciously discourage sedentary activities and encourage LTPA can be helpful. Physically inactive leisure activities such as those spent in front of TV or computer screens compete against LTPA time [26] and parental control is perhaps necessary to set strict limits on those activities to leave room for youth to participate in LTPA during after-school hours. In addition, based on the finding that parental PE engagement is a positive correlate of the child's LTPA participation, parents can be positive role models and/or supportive exercise partners for their children by themselves leading an active lifestyle. By contrast, parental housework, competing against PE both in time and in energy, appears to be negatively linked to the child's LTPA participation. These results clearly point to the importance of parental physical activity patterns for the child's LTPA participation.

Since over 90% of AN positive children in this study were obese, parental motivation for LTPA at the family level might well be contingent upon their knowledge and perception of children's body weight. There is evidence that misconception of children's body weight on the part of many Mexican-American parents constitutes a serious challenge to obesity prevention and control. For example, based on survey data from 200 parents with obese children, mostly Hispanic, one study reported that 35% of these parents did not believe their obese child was

overweight [31]. It is common for parents of Mexican origin to believe that chubby babies are healthier than their leaner counterparts [32, 33]. There is also evidence that Mexican-American mothers of obese children more often select a chubby baby as the ideal baby than mothers of non-obese children [34]. Understanding these cultural traits and their implications to parental perception of child bodyweight and health becomes important to devise effective family-based interventions aiming to reduce risk of obesity and type 2 diabetes among Mexican-American families with AN-positive children.

The second key message is that the health of both children and parents matters. We find that the child's fair/poor health and the parent's obesity are negatively correlated with child LTPA participation. Presumably, parents' lack of stamina or motivation to promote LTPA in the family due to their own health issues can negatively impact child LTPA participation. Poor health of the child can be a even more direct barrier of his or her LTPA participation possibly due to energy deficiency and/or physical discomfort associated with exercising. Indeed, at-risk youth, already afflicted with suboptimal health, may shy away from LTPA for physical reasons rather than due to some intrinsic 'laziness' as often labeled implicitly in people's minds. These non-behavioral causes of physical inactivity need to be kept in mind when designing interventions to promote active living lifestyle. In some circumstances, behavioral interventions are simply not sufficient to tackle certain stubborn biological causes of physical inactivity.

As far as we know, this study is the first to report on LTPA patterns and correlates among Latino youth with AN. The literature on AN and the literature on LTPA have been developed separately with little overlap. We know AN is found more among overweight ethnic minorities such as blacks and Latinos with insulin resistance and/or type 2 diabetes [12, 18, 28]. and we also know LTPA can be beneficial for at-risk AN-positive youth [10, 27]. But we were unable to

find a similar study to compare results. This absence clearly indicates the need of conducting research on the connected issues of LTPA, AN, and ethnic minority youth to fill an important knowledge gap.

Several study limitations are noteworthy. This study is cross-sectional and observational by design. While cross-sectional studies are not without merit, a key limitation is that causality in the observed associations cannot be determined. Other important limitations of our study include a small sample size, non-representative sample, and omitted variables. For example, due to the residential proximity of the sampled families, no neighborhood effects can be tested and the widely-accepted ecological framework of human behavior cannot be evaluated [23]. That said, individual- and family-factors seem to be more influential than contextual factors on individual health-related outcomes as revealed in many studies of neighborhood effects on health [11].

It has been suggested that the purpose of the study of PA correlates should be explicitly linked to improvement in PA intervention development [24]. Meanwhile, it is also recognized that the greatest challenge for this field is translation of research into public health action [2]. Our study contributes to our understanding of LTPA correlates of AN-positive youth and attempts to inform group-specific interventions to increase LTPA in at-risk youth. More group-specific studies of PA correlates are warranted, especially those equipped with more rigorous designs such as prospective cohort studies of large-scale representative samples. Additionally, our study focused on a Latino population near the Mexican border. Future studies aimed to identify LTPA correlates among populations of diverse racial and ethnic backgrounds could provide valuable context to the results of this research.

In conclusion, socio-demographic factors are not significant LTPA correlates in AN-positive youth. Time spent in competing activities, such as screen time for children and

household chores for parents, is the most consistent factor negatively linked to a child's LTPA levels, whereas parental PE engagement is a strong positive correlate with LTPA. Meanwhile, poor health of children and parents seems to be a barrier to child LTPA participation.

Intervention strategies that take both the behavioral and the non-behavioral causes of physical inactivity into account may improve the outcomes of efforts to increase LTPA among AN-positive youth.

NEW CONTRIBUTION TO THE LITERATURE

To the best of our knowledge, this is the first study reporting LTPA patterns and correlates of Latino youth who exhibit skin markers of insulin resistance and are at higher risk of developing metabolic syndrome. The following bullet points highlight new evidence provided by this study:

- The parent's living an active living lifestyle is a significant and positive correlate of the child's LTPA participation net of confounding factors.
- Time-competing activities such as the parent's doing housework and the child's spending time in front of screen are negatively associated with LTPA.
- The child's or the parent's poorer health status is negatively associated with the child's LTPA participation.
- Parental socioeconomic factors are not significantly associated with LTPA among this special pediatric population.

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Table 1. Sample Statistics of Youth with Acanthosis Nigricans and Their Biological Parents

<u>Sample Statistics on Youth</u>			
Variables	Mean or Percentage	Variables	Mean or Percentage
Leisure-time physical activity		Hypertension	22.7
never	8.9	Diabetes	4.9
less than once a week	9.8	Fair/poor self-rated health	15.3
once or twice a week	24.3	TV/Game time per day	
Once every other day	21.6	≤ 1st quartile (45 min)	21.1
every day	35.4	> 1st quartile & ≤ median (60 min)	5.2
Age at survey (years)	10.5	> median & ≤ 3rd quartile (120 min)	33.4
Male gender	43.5	> 3rd quartile (120 min)	40.3
Obesity	90.9		
<u>Sample Statistics on Parents</u>			
Education (years)		Obesity	62.3
≤12	82.8	Diabetes	
>12 & ≤16	10.1	neither parents diabetic	68.0
>16	7.1	one parent diabetic	27.8
Employment status		both parents diabetic	4.3
work full time	33.6	Extended family member diabetic	70.8
work part time	19.3	Fair/poor self-rated health	29.7
unemployed or other	47.1	Physical exercise time per day (minutes)	
Per capital family annual income (\$)	4576.4	< 30	26.3
		≥ 30	61.0
		missing	12.7
		Housework time per day (minutes)	149.5

Source: The 2011-2012 TRAT2DC and The 2012 SFBAAN conducted in Lower Rio Grande Valley

Table 2. Odds Ratios of Ordinal Logit Models of Leisure-time Physical Activity of Latino Youth with Acanthosis Nigricans

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Child TV/Game Time	Child Health Conditions	Parent Socioeconomic status	Parent Health Conditions	Parent Physical and Other Activities	Final Model
Child age (continuous)	1.08	1.07	1.05	1.14**	1.08	1.09
	(0.97 - 1.20)	(0.96 - 1.18)	(0.95 - 1.17)	(1.01 - 1.29)	(0.97 - 1.21)	(0.97 - 1.22)
Child gender (male)	1.39	1.47*	1.40	1.51	1.43	1.32
	(0.92 - 2.12)	(0.96 - 2.24)	(0.91 - 2.15)	(0.92 - 2.48)	(0.92 - 2.21)	(0.83 - 2.12)
TV/game time per day (min)						
≤45	REFERENCE					REFERENCE
> 45 & ≤ 60	0.82					1.08
	(0.31 - 2.20)					(0.36 - 3.24)
> 60 & ≤ 120	0.83					0.93
	(0.47 - 1.48)					(0.48 - 1.80)
> 120	0.46***					0.45**
	(0.26 - 0.80)					(0.24 - 0.85)
Child obesity (yes)		0.89				
		(0.42 - 1.87)				
Child hypertension (yes)		1.37				
		(0.83 - 2.26)				
Child diabetes (yes)		0.78				
		(0.30 - 2.05)				
Child fair/poor SRH (yes)		0.34***				0.42***
		(0.19 - 0.61)				(0.22 - 0.79)
Parent education (≤12 yrs)			REFERENCE			
Parent education (>12 & ≤16 yrs)			0.70			
			(0.35 - 1.39)			
Parent education (>16 yrs)			1.08			

			(0.43 - 2.68)			
Parent work full time			REFERENCE			
Parent work part time			0.77			
			(0.42 - 1.43)			
Parent unemployed or other			0.99			
			(0.61 - 1.60)			
Per capita family income (\$)			1.00			
			(1.00 - 1.00)			
Parent obesity (yes)				0.57**		0.63*
				(0.34 - 0.94)		(0.39 - 1.01)
Neither parents diabetic				REFERENCE		
One of the parent diabetic				0.67		
				(0.37 - 1.19)		
Both parents diabetic				0.44		
				(0.12 - 1.58)		
Extended family member diabetic (yes)				1.56		
				(0.90 - 2.70)		
Parent fair/poor SRH (yes)				0.90		
				(0.68 - 1.20)		
Parent physical exercise time (PPET) < 30 minutes per day					REFERENCE	REFERENCE
PPET >= 30 minutes per day					2.27***	2.20***
					(1.39 - 3.71)	(1.31 - 3.70)
PPET missing					0.72	1.07
					(0.29 - 1.79)	(0.40 - 2.90)
Parent housework time (standardized)					0.77**	0.76**
					(0.62 - 0.96)	(0.58 - 0.98)

Source: The 2011-2012 TRAT2DC and The 2012 SFBAAN conducted in Lower Rio Grande Valley.

95% confidence intervals in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%